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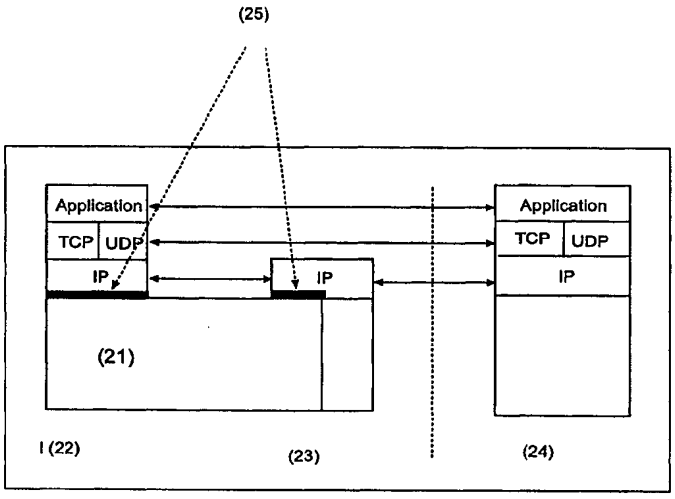
(54) **Title:** FILTERING OF IP-PACKET TRAFFIC IN GPRS



(57) **Abstract**

Phase 1 of the standard for GPRS (General Packet Radio Service), which is a packet switched data service for GSM and which frequently is used towards Internet, does not support quality differentiation of IP-packets that have the same IP-address. This results in, inter alia, that client applications, which don't have strict requirements on delays, can reduce the quality for delay-sensitive client applications. The invention describes how the IP-packets are arranged to pass a packet filter that restricts the amount of data that each client application is allowed to transmit, by which the user will have possibility to make quality requirements on IP-traffic over Internet. Defining filter functions for a client application means that: the user describes how the IP-packets from a client application are identified; the user decides allowed bandwidth for each client application; the user decides rules for allocation of transmission capacity that a client appication momentarily does not utilise.

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Filtering of IP-packet traffic in GPRS.

TECHNICAL FIELD

The invention describes a way to filter packet traffic whereby the user will have a chance to make quality requirements on the packet traffic so that quality parameters can be indicated for the client applications that are utilised.

The invention provides functionality that makes it possible for the user himself/herself to decide how large part of the allocated total resources that shall be used for each client application.

The invention especially describes a way to filter packet traffic in GPRS (General Packet Radio Service), which is a packet switching data service for GSM. With only minor additions to phase 1 of the GPRS-standard, the invention will give the user a considerably better experienced quality. Client applications that are less sensible to delays, for instance file transmissions with FTP (File Transfer Protocol), can give of the common capacity to delay-sensitive client applications, for instance "Voice over IP", with UDP (User Datagram Protocol).

PRIOR ART

GPRS (General Packet Radio Service) is a packet switched data service for GSM, and in the first place constitutes a mobile Internet access, but can also create access to other packet switched data networks, such as X.25. The GPRS system is connected to the data network via a GGSN (Gateway GPRS Support Node). IP-packets, which are coming to GGSN, will be tunnelled to the mobile station via a fixed network and a radio based network.

According to the GPRS-standard, all IP-packets that have the same IP-address will be associated with a PDP-context, which is in the mobile terminal, SGSN and GGSN. PDP-context is a register, which inter alia contains a QoS-profile (quality profile) for the IP-access of the terminal, and information that is required for changing location of the terminal within the GSM-network (information for mobility). The quality profile inter alia describes which maximal bandwidth that is available to the user, and requirements on maximal delay. This means that all IP-packets with the same IP-address will be managed in the same way, irrespective of the varying requirements on delay that the client applications make on the GPRS carrier.

The need to make quality requirements (QoS) is well known. QoS is managed in a lot of protocols, but management of QoS for IP-traffic on Internet is not solved.

A client application can be carried by different types of transport protocols. A client application that requires that information is delivered correctly and in the same order as it was transmitted uses TCP (Transmission Control Protocol), and a client application that instead has more strict delay requirements uses UDP (User Datagram Protocol).

TECHNICAL PROBLEM

If a user utilises a plurality of client applications, the requirements on QoS can differ between the different client applications that the user has activated. Use of client applications where packet switched transmission is utilised can by that result in differentiated requirements on the transmission. For instance use of certain client applications makes strict requirements on rapid transmission, whereas use of other client applications may

make requirements on that the transmitted packets shall arrive in the same order as they were transmitted.

Phase 1 of the standard for General Packet Radio Service (GPRS) does not support quality differentiation of IP-packets that have the same IP-address. This means that all IP-protocols that have the same IP-address will share a common transmission capacity, and the allocation can not be controlled with regard to which requirements that are made. This means inter alia that client applications which do not have strict requirements on delays can reduce the quality for delay-sensitive client applications.

When control of the transmission with regard to quality can not be made, activation/use of certain client applications are at the same time prevented or influenced. Wanted parallel execution then can be impossible, so sequential execution, or in another way restricted execution, must be client-applied.

To base the QoS-management on that a user can be allocated a plurality of IP-addresses, according to GPRS phase 1, is insufficient primarily for two reasons:

- There is a great shortage of IPv4-addresses, which strongly reduces the possibility for a user to use an IP-address for each client application.

- Workplace equipment (PC) is normally not configured to support a plurality of IP-addresses at the same time.

TECHNICAL SOLUTION

IP-packets that are transmitted over GPRS are encapsulated and tunnelled through the connecting network. The invention describes how the IP-packets that are tunnelled over the

GPRS-carrier, are arranged to pass a packet filter, which reduces the amount of data that each client application is allowed to transmit. The user can by the filtering himself/herself decide how much of the available bandwidth that shall be used for each client application.

The invention can be implemented in mobile terminals that are using a GPRS-carrier for connecting themselves to the Internet. The invention also can be implemented in the GGSN-nodes of the GPRS-system.

ADVANTAGES

The invention provides functionality which makes it possible for the user himself/herself to decide how large part of the to the user allocated total resources that shall be used for each client application.

Available network resources can be allocated between those client applications that are activated, so that the sensible client applications will have the capacity that is necessary for satisfactory transmission. Other, less sensible, client applications will have access to limited resources. Since the requirements are smaller for these client applications, they are less harassed by the capacity being limited or varied. If, on the other hand, a client application does not utilise allocated capacity in full, the free capacity will be allocated to any other client application that has possibility to benefit by increased transmission capacity. The user then will experience a totally improved quality of the transmission.

The described packet filter for QoS-management in the GPRS-system introduces a new technology to differentiate and prioritise between different client applications. By prioritizing and differentiation in the IP-traffic, a more

flexible system for transmission and better chances to fulfil time and quality requirements is effected so that client applications can be satisfactorily utilised. By these arrangements, network resources can be utilised in a better way, and there will be possibilities to avoid or postpone investments.

LIST OF FIGURES

Figure 1 shows access to the Internet by GPRS.

Figure 2 shows a mobile terminal connected to the Internet via a GPRS-carrier.

Figure 3 shows four client applications that share common transmission capacity.

EXPLANATION OF TERMS

FTP	(File Transfer Protocol) Ordinary file transport protocol on the Internet.
GGSN	(Gateway GPRS Support Node) Node in the GSM-network that connects the fixed network part of GPRS with the Internet.
GPRS	(Generalised Packet Radio Service). Packet switched data service for GSM.
GSM	Global System for Mobile communication.
IPv4-addresses	Address in the Internet according to the standard for IP-protocol version 4.

MSC	(Mobile Switch Center). Switching node in mobile networks with functions in the first hand for change of base.
PDP-context	Register with information about inter alia QoS and information necessary to make mobility possible.
PDP-address	The address that is indicated by GPRS. In the case with connection via Internet, PDP-address = IP-address, but can also be another address, for instance X.25-address.
QoS	(Quality of Service) Parameters that define wanted performance.
SGSN	(Serving GPRS Support Node). Node in the GSM-network that manages data packets from mobile telephone.
TCP	(Transport Control Protocol). Protocol, which frequently is used when high requirements are made on that the information is delivered correctly and in the same order as it was transmitted.
Tunnel, Tunnelling	A technology which means that data packets can be encapsulated so that they can be transmitted to a destination without being influenced by protocols between them.
UDP	(User Datagram Protocols). Protocols, which are frequently used when high

requirements are made on that the delay is limited.

DETAILED DESCRIPTION

The description below refers to the figures in the enclosed appendix of drawings.

GPRS

Packet data traffic over a GSM-network is effected by GPRS (1) (Generalised Packet Radio Service). GPRS supports standard protocols and co-operates with packet switched networks such as IP-networks and X.25-networks. Both intermittent and burst transmissions, and single transmissions with large amounts of data, are managed. GPRS is realised by two types of nodes in the GSM-network: GGSN (2) (Gateway GPRS Support Node) and SGSN (3) (Serving GPRS Support Node). These nodes are on the same hierarchical level as MSC in the GSM-network.

SGSN (3) keeps count of the location of the mobile telephone within its service area, transmits and receives data packets from the mobile telephone, forwards them or receives them from GGSN. Co-operation with external packet data networks is made by GGSN, which converts the GSM-packets to other packet protocols (for instance IP or X.25) and transmits the GSM-packets to other communication networks.

A mobile terminal (5) logs on to the data network, for instance Internet (4), separately for GPRS. After that, a PDP-context (6) is established, which is a logic connection between the mobile telephone and GGSN. PDP-context can be described as being represented by registers in the mobile terminal, SGSN and GGSN. The registers inter alia contain

information regarding QoS, security and such information that is needed to effect mobility, such as information about base stations (7, 9) etc. The mobile terminal is identified from the packet data network by means of a PDP-address. Each such PDP-address is described in the individual representations of PDP-context (6) in the mobile terminal (5), SGSN (3) och GGSN (2). When this is made, the mobile terminal is visible outside the network where the mobile terminal is logged in, for instance Internet (4) and can by that transmit and receive packets.

At establishing connection towards Internet (4), a "tunnel" is established through GPRS from GGSN and to the mobile terminal. The traffic in the tunnel can be controlled by the subscription that the user utilises for the communication. QoS-requirements will be decided and constant for all packets to same PDP-address by this subscription.

PDP-context contains inter alia information about quality aspects and information that is necessary to make possible mobility. PDP-context is represented in the mobile terminal, SGSN and GGSN. The connection from mobile terminal via base station and SGSN to GGSN is registered in PDP-context. When the mobile terminal is moved during session in progress, change of base can be made. This then also results in that the connection of the mobile terminal to SGSN is changed, which is illustrated by dashed lines in Figure 1 (SGSN 8 and base station 9). Information to make it possible to perform such changes is in the PDP-context (6).

THE LOCATION OF THE PACKET FILTER

Figure 2, which shows the protocol stacks on the mobile working place (22), in GGSN (23) and in the receiving data

network (24), describes the location of the packet filtering in the communication. IP-packets that are transmitted over GPRS are encapsulated and tunnelled through the connecting network (GPRS-carrier 21) between the mobile station and GGSN. A packet filter (25) is located in the protocol stack between the IP-layer (25) and the GPRS-carrier (21). In Figure 2, the packet filter can be seen as a black-marked area in the lower part of the IP-layer. By that, the IP-packets will pass the packet filter before the tunnelling over the GPRS-carrier. By the filter the amount of data that a client is allowed to transmit is restricted so that the packets are allocated the priority in the transmission that the user has requested. The user can in that way by the filtering himself/herself decide how much of the available bandwidth that shall be used for each client application.

PREFERRED EMBODIMENT

The packet filter consists of the following logical units:

- **The packet classifier**, which sorts the incoming traffic according to predefined information in the IP-packet.

- **The counter**, which registers and compares the number of incoming IP-packets belonging to the same client application with a predefined profile.

- **The flow limiter**, which throws the IP-packets that exceed the for the client application maximally allowed number of IP-packets per time unit (the bandwidth).

Defining filter functions for a client application means that:

- the user describes how the IP-packets from the client application are identified.

  In the first place, identification of transport protocols (for instance TCP or UDP) and port numbers, are used, but when necessary, other information from higher protocol layer is utilised.

- the user decides which bandwidth each client application is allowed to use.

- the user decides rules for how the packet filter shall allocate the transmission capacity that a client application for the time being does not utilise.

THE UTILISATION OF THE BANDWIDTH

If a client application does not utilise the whole allocated bandwidth, another client application is given access to extra bandwidth.

Figure 3 shows an example of the utilisation of the bandwidth.

In the upper picture of the Figure is shown how the totally available bandwidth is allocated between four client applications (A, B, C and D), two (B and C) that utilise the TCP-protocol, and two (A and D) that utilise the UDP-protocol. Suppose that the TCP-application B is allowed to use also the transmission capacity that has been allocated to the UDP-applications A and D during the time when the UDP-applications do not utilise the whole bandwidth.

In the lower picture is shown an example where the client applications A and D do not utilise the whole allocated

bandwidth, at which the client application B can be allocated a certain extra transmission capacity (31).

In this way the available bandwidth will be better utilised, and in the example no transmission capacity will be left unutilised. The user experiences that the client applications A and D will have the capacity that is necessary, at the same time as the client application B will have increased capacity in addition to the initially allocated.

The invention is not limited to above described embodiments but may in addition be subject to modifications within the frame of the following patent claims and the idea of the invention.

PATENT CLAIMS

1. A packet filter for management of quality parameters at packet switched data transmissions to and from different client applications, c h a r a c t e r i s e d in a possibility to make quality requirements on the packet traffic separately for each of said client applications.

2. A packet filter as claimed in patent claim 1, c h a r a c t e r i s e d in that said quality requirements relate to at least bandwidth or delay, and that quality requirements can be made on traffic in IP-networks and/or in X.25-networks.

3. A packet filter as claimed in patent claim 1, or 2, c h a r a c t e r i s e d in that the packet traffic is transmitted over mobile telephone networks by utilisation of GPRS.

4. A packet filter as claimed in patent claim 3, c h a r a c t e r i s e d in that the packet traffic is executed according to the IP-protocol and that the filter is located in the protocol stack between the IP-layer (25) and the GPRS-carrier (21) so that the IP-packets will pass the filter before the transmission, which is executed by the GPRS-carrier (21).

5. A packet filter as claimed in any of patent claims 1 to 4, c h a r a c t e r i s e d in that the user of any of said client applications decides which resources that shall be used for each of these said client applications.

6. A packet filter as claimed in any of patent claims 1 to 5, c h a r a c t e r i s e d in that quality requirements are made on transmissions with transmission protocols that are used in Internet, such as TCP and UDP.

7. A packet filter as claimed in any of patent claims 1 to 6, c h a r a c t e r i s e d in that QoS is differentiated for IP-traffic on Internet for different client applications with the same IP-address.

8. A packet filter as claimed in any of patent claims 1 to 7, c h a r a c t e r i s e d in:

that the amount of data that each of said client applications (A, B, C, D) is allowed to transmit, is limited.

that transmission capacity (31) that has been allocated to any of said client applications but has not been utilised, can be allocated to any other of said client applications.

that allocation between said client applications of the utilisation of the available bandwidth can be decided at the utilisation of the client applications.

9. A packet filter as claimed in any of patent claims 1 to 8, c h a r a c t e r i s e d in the following elements:

a packet classifier, which sorts the incoming traffic according to information in transmitted packets.

a counter, which registers and compares the number of incoming packets belonging to the same client application with a predefined profile.

a flow limiter, which rejects packets so that the number of packets per time unit, which is allowed for the client application that the packet relates to, does not exceed maximally allowed number of packets per time unit.

10. A packet filter as claimed in any of patent claims 1 to 9, c h a r a c t e r i s e d in that filter functions for a client application are defined by:

a description of how packets, which are transmitted, are identified.

allocation of bandwidth for each client application.

control of allocation of transmission capacity that temporarily is not utilised.

11. A method for quality filtering of packet switched data transmissions, c h a r a c t e r i s e d in that quality requirements are made on packet traffic separately for each one of active client applications.

12. A method as claimed in patent claim 11, c h a r a c t e r i s e d in that said quality requirements relates to at least bandwidth, or delay, and that differentiated quality requirements can be made on traffic in IP-networks and/or in X.25-networks.

13. A method as claimed in patent claim 11, or 12,

c h a r a c t e r i s e d in that said packet traffic is transmitted over mobile telephone networks.

14. A method as claimed in patent claim 13, c h a r a c t e r i s e d in that said packet traffic utilises GPRS.

15. A method as claimed in any of patent claims 11 to 14, c h a r a c t e r i s e d in that the packet traffic is executed according to the IP-protocol, and that the quality filtering is made by a packet filter that is located in the protocol stack between the IP-layer (25) and the layer with GPRS (21).

16. A method as claimed in patent claim 15, c h a r a c t e r i s e d in that said packet filter comprises the following elements:

packet classifier, which sorts the traffic according to information in transmitted packets.

counter, which for each of said client applications registers and compares the number of transmitted packets belonging to said client application with a predefined profile.

flow limiter, which limits the packet flow for a client application with regard to maximally allowed number of packets per time unit.

17. A method as claimed in any of patent claims 11 to 16, c h a r a c t e r i s e d in dynamic allocation of transmission capacity between said client applications.

18. A method as claimed in any of patent claims 11 to 17, c h a r a c t e r i s e d in:

that the amount of data that each of said client applications (A, B, C, D) is allowed to transmit is restricted.

that transmission capacity (31), which is allocated to one of said client applications, but is not utilised, is allocated to any other of said client applications.

that the user dynamically can decide how the utilisation of the available bandwidth shall be allocated between said client applications.

19. A method as claimed in any of patent claims 11 to 18, c h a r a c t e r i s e d in:

identification of packets from said client applications.

allocation of bandwidth to each of said client applications.

control of allocation of transmission capacity that momentarily is not utilised.

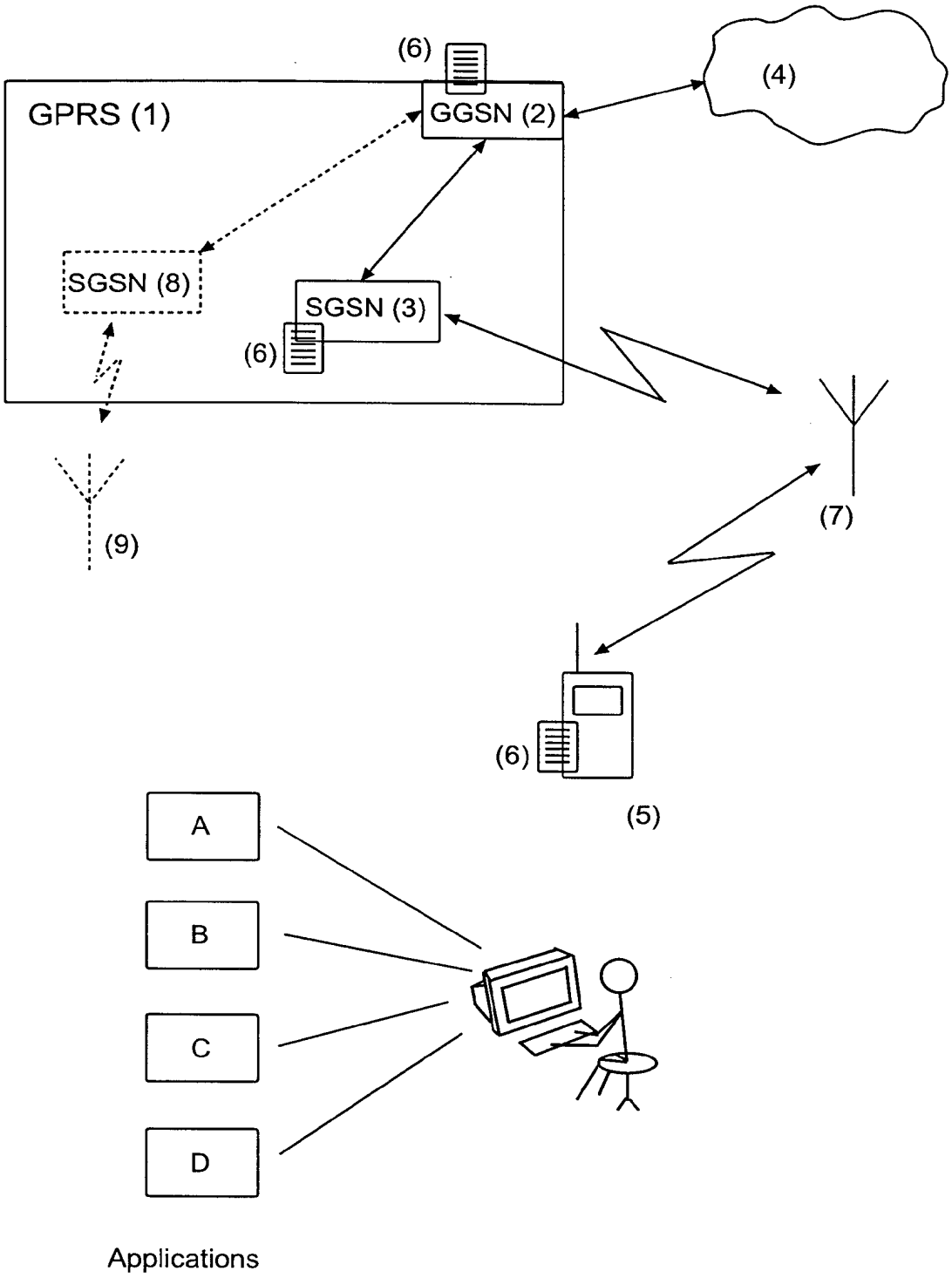
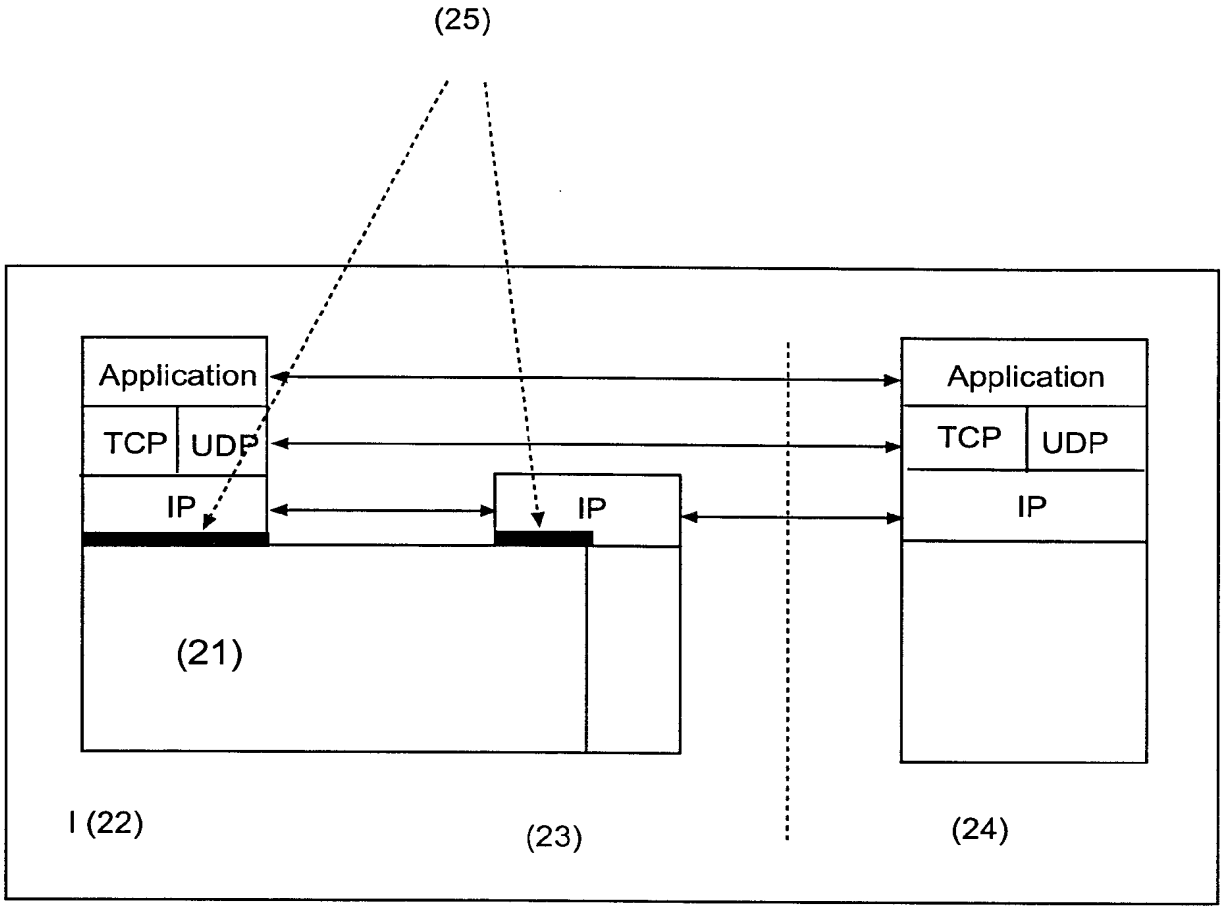


Figure 1


(25)
Application
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UDP
IP
IP
Application
TCP
UDP
IP
(21)
I (22)
(23)
(24)

Figure 2

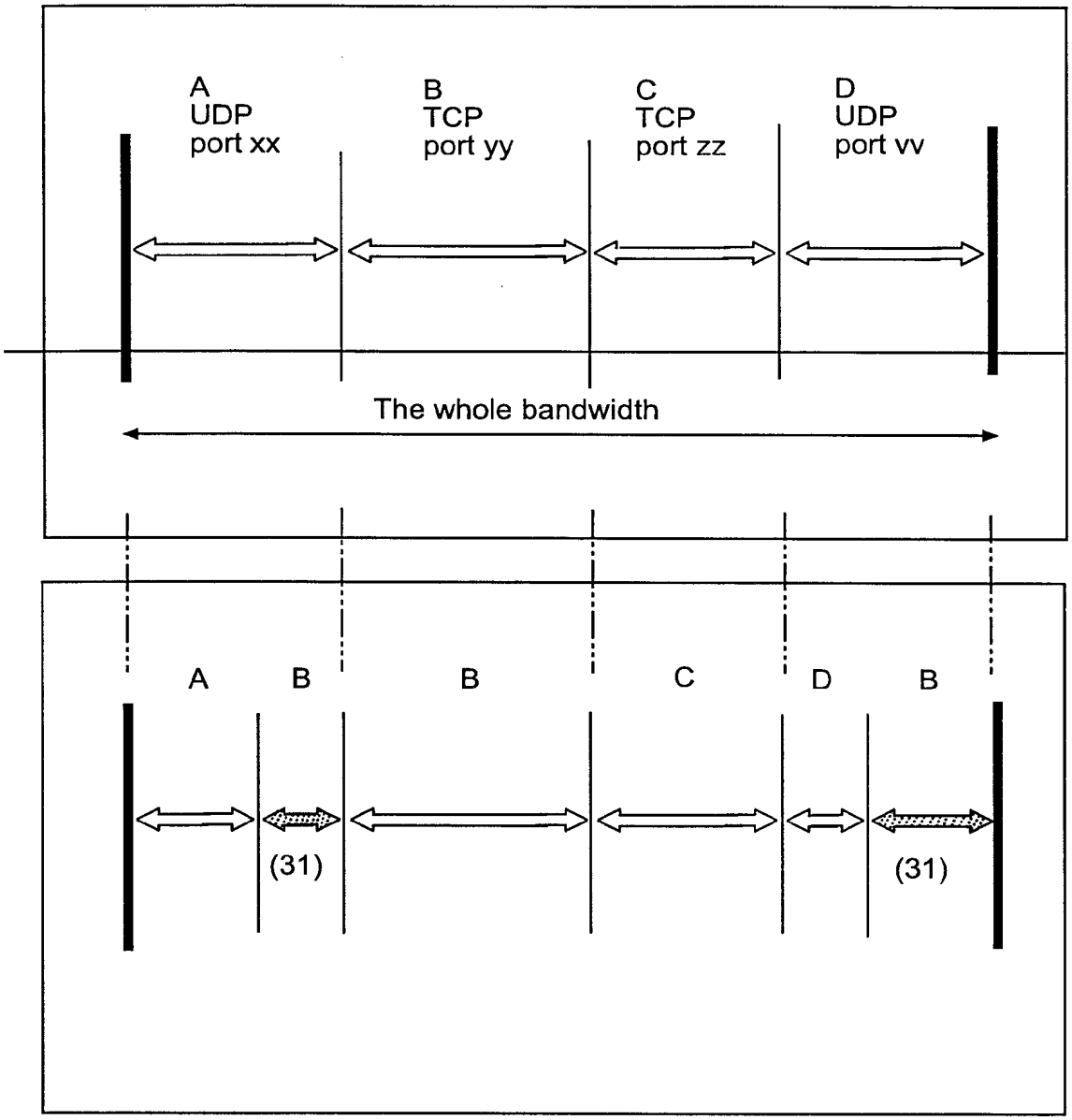
A
UDP
port xx
B
TCP
port yy
C
TCP
port zz
D
UDP
port vv
The whole bandwidth
A
B
B
C
D
B
(31)
(31)

Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/02279

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/56, H04Q 7/22
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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P,X	WO 9916266 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 1 April 1999 (01.04.99), page 20, line 14 - page 22, line 21, figure 7	1-19
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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13 April 2000	03 -05- 2000
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/02279

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
PCT/SE 99/02279

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